PROC. ENTOMOL. SOC. WASH.
83(3), 1981, pp. 413–420

DISTINGUISHING CHARACTERS OF THE REPRODUCTIVE SYSTEM AND GENITALIA OF *XESTIA DOLOSA* AND *XESTIA ADELA* (LEPIDOPTERA: NOCTUIDAE)

ANNE HUDSON

Biosystematics Research Institute, Agriculture Canada, Ottawa, Ontario K1A 0C6.

Abstract.—The spiral fertilization canal of females and the aedeagus of males are described and can be used to identify *Xestia dolosa* Franclemont and *Xestia adela* Franclemont in sympatric populations in eastern and southwestern Ontario.

Xestia dolosa Franclemont and *Xestia adela* Franclemont, until recently known as the large and small forms of *Amathes c-nigrum* (Linnaeus), were described as two new species by Franclemont (1980) on the basis of differences in size, colour, and genitalia of both males and females. The shape of the ostial plate and its excavation in the females of the two species is quite distinct in most specimens, although specimens intermediate in size are often intermediate in this character also, at least in the eastern and southwestern Ontario populations we have examined (Hudson and Lefkovitch, 1980). Characters of the male genitalia are also difficult to interpret in individuals of intermediate size.

During a study of isozyme variation in the two species, Hudson and Lefkovitch (1980) found that two allozymes of adenylate kinase could be used to distinguish *X. dolosa* from *X. adela* in sympatric populations in Ontario; a faster moving band Adk^f characterized *adela*, whereas *dolosa* was distinguished by a slower band Adk^s. Examination of the reproductive systems and genitalia of moths segregated in this way revealed two additional characters useful for identification.

This paper describes the differences seen between the species in the sclerotized portion of the spermathecal duct (fertilization canal) of the females, and in the extent and number of spines on the sclerotized plate (keel-like carina of Callahan and Chapin, 1960) at the distal end of the aedeagus of the males.

MATERIALS AND METHODS

The moths used for this study were collected in light traps set in North Gower near Ottawa, London, and Harrow, Ontario. Genitalia and repro-

ductive systems of both sexes were examined by light microscopy and with a scanning electron microscope.

1. Light microscopy.—Female reproductive systems were dissected in water, fixed in Kahle's fluid, stained with carmine, and mounted in venetian turpentine in absolute alcohol. Male genitalia were dissected in water, dehydrated through an alcohol series, cleared in xylol, and mounted in Permount.

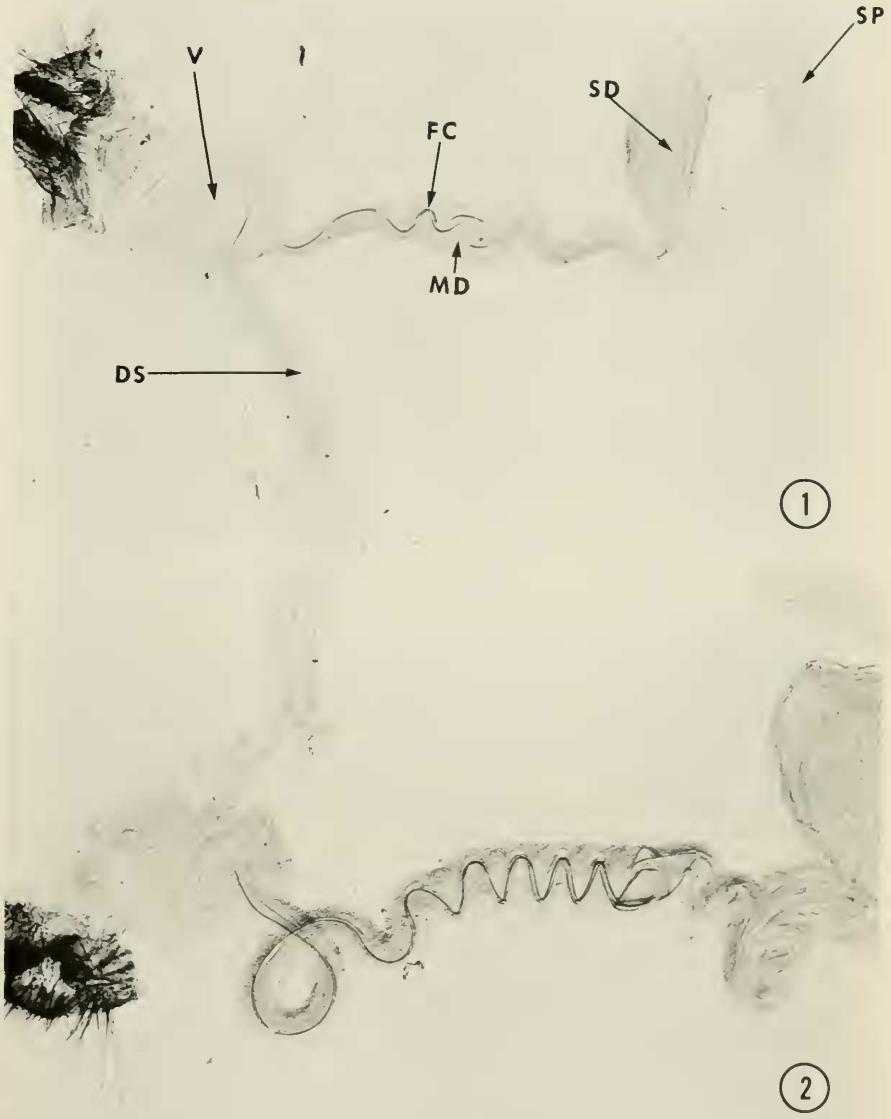
2. Electron microscopy.—The dissected aedeagi were attached to the specimen holder with silver conductive paint, coated with gold, and examined in a Cambridge Stereoscan microscope.

Results

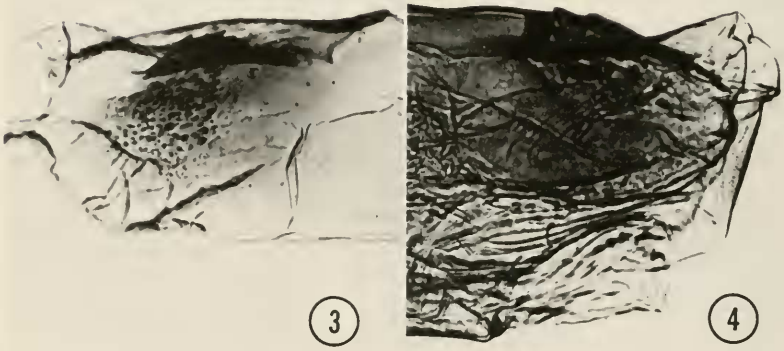
The spermatheca of *X. adela* is a "U-shaped" sac with distinct proximal and distal regions, although it is not clearly separated into two lobes as it is in *Peridroma saucia* (Huebner) (Callahan and Cascio, 1963). The proximal region of the sac appears to be surrounded by circular muscle whereas the distal region is distinguished by a change to longitudinal fibres (Fig. 1). A spermathecal gland (not shown in Fig. 1) approximately 2.0 cm long extends anteriad from the apex of the proximal region and consists of a central duct surrounded by secretory cells as described in *Heliothis zea* (Boddie) by Callahan and Cascio (1963) and in *Choristoneura fumiferana* (Clemens) by Outram (1971). The distal end of the spermatheca extends into the spermathecal duct, which is itself composed of three parts. The most anterior part of the duct is variously coiled in different individuals, the length of this region being 1.12 mm ± 0.13 (n = 11). In the second (central) part, the main duct widens and remains straight, and contains the sclerotized spiral segment of the fertilization canal (Fig. 1). The length of the main duct containing the spiral is 1.08 mm ± 0.23; the spiral consists of two gyres. At the distal end, the fertilization canal straightens and continues within the main duct to the opening into the vestibulum at a point slightly to the left of the seminal duct openings. The length of this third portion of the duct is 0.89 mm ± 0.15. The total length of the spermathecal duct in *X. adela* is 2.98 mm ± 0.71.

In *X. dolosa* the spermatheca and the spermathecal gland are similar to those of *X. adela*, but the spermathecal duct is different (Fig. 2). The first portion is longer, 2.48 mm ± 0.29 (n = 12), and more tightly coiled. The length of the main duct containing the spiral fertilization canal is also longer, 2.12 mm ± 0.14, and the spiral itself consists of four gyres. The main duct containing the fertilization canal coils again before entering the vestibulum, and is much longer in proportion to the other two parts of the duct than it is in *X. adela*. The total length of the spermathecal duct in *X. dolosa* is 8.50 mm ± 0.40.

The male genitalia of *X. dolosa* and *X. adela* as figured by Franclemont



Figs. 1, 2. Spermatheca and spermathecal duct. 1, *Xestia adela*. 2, *X. dolosa*. DS = ductus seminalis; FC = fertilization canal; MD = main spermathecal duct; SD = distal lobe of spermatheca; SP = proximal lobe of spermatheca; V = vestibulum.

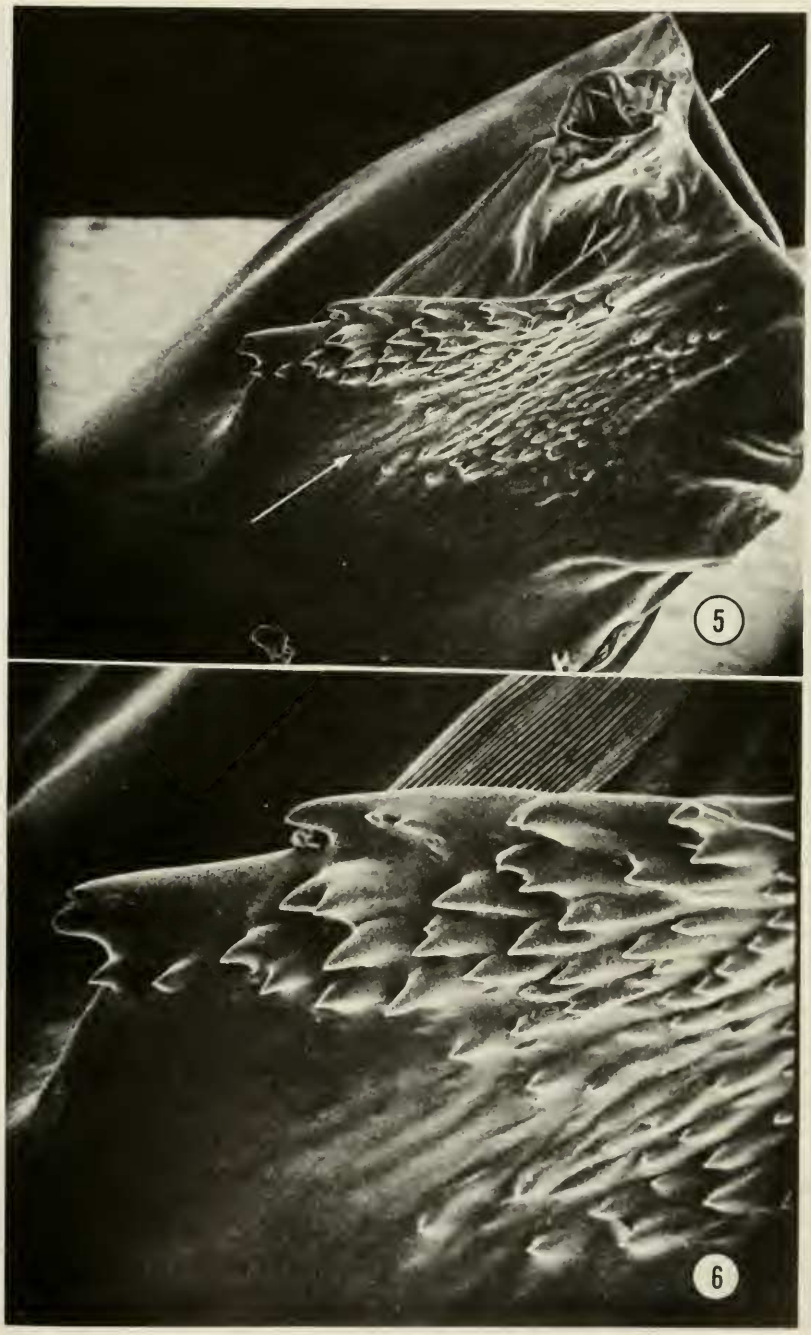


Figs. 3, 4. Carina on aedeagus. 3, *Xestia adela*. 4, *X. dolosa*.

(1980) show some differences in size and in the expansion of the sacculus. We have examined individuals identified by electrophoresis and Adk assay and found that the aedeagus offers the most easily recognizable morphological character in the males. It is bow-shaped in both species approximately 3.30 mm ± 0.01 long in *X. dolosa* and 3.00 mm ± 0.01 in *X. adela* (n = 20). The armature at the distal end appears as a keel-shaped structure situated on the ventral side of a slight distal cleft. The area is dark in colour and is similar in length in both species (0.33 mm ± 0.01 in *X. dolosa* and 0.329 ± 0.02 in *X. adela*, n = 20). The differences in general appearance and arrangement of the spicules are as figured (Figs. 3–8). The large number of subsidiary spicules in *X. adela* males are easily visible through the manica on dissection and are absent in *X. dolosa* (Figs. 3, 4).

Discussion

In sympatric populations collected in the Ottawa area, London, and Harrow, Ontario, the two characters described herein can be used reliably to identify *X. dolosa* and *X. adela*. The spiral fertilization canal has been described in several species of Lepidoptera, e.g., *Dioryctria abietella* (Denis and Schiffermüller) (Fatzinger, 1970), *Pseudaletia unipuncta* (Haworth) (Callahan and Chapin, 1960), and *Euxoa auxiliaris* (Grote) (Drecktrah, 1978). Wilkes (personal communication) examined the spiral canal in 36 species of Noctuidae and found that in the genus *Euxoa* the number of gyres varied from 1–14, but the number found in a single species was generally constant.



Figs. 5, 6. Scanning electron micrograph of the carina of *Xestia adela*. 5, ×170; upper arrow = distal end of aedeagus; lower arrow = carina. 6, ×450.

Figs. 7, 8. Scanning electron micrograph of the carina of *Xestia dolosa*. 7, ×200. 8, ×500. Arrows as for Fig. 5.

The patterns of spines and clusters of cornuti on the aedeagi of Lepidoptera are frequently included in species descriptions of male genitalia, but are seldom viewed in detail. McDunnough (1943) mentioned that these characters were the most useful in identifying species of *Nycteola* (Noctuidae). Franclemont (1951) illustrated the aedeagi of a number of species of *Pseudaletia* (Noctuidae), showing what appear to be distinctly characteristic patterns of spicules.

In a detailed study of the reproductive systems of *Pseudaletia unipuncta* and *Peridroma saucia* (as *P. margaritosa* (Haworth)), Callahan and Chapin (1960) described a keel-like carina situated on the posterior region of the sclerotized portion of the aedeagus of the latter. They observed that, while inserted, the carina hooked behind the anterior inner edge of the lamella antevaginalis, and suggested that since in *P. saucia* the bursa is a membranous sac and the endophallus bears no cornuti, the carina might serve to lock the organs together during mating.

The structures observed on the aedeagi of *X. dolosa* and *X. adela* have the same general shape as the carina of *P. saucia* and may function in the same way, although the bursae in both are bisacculate with the long arm-bearing signa, and the endophallus appears to be spiculate.

Acknowledgments

I thank W. G. Forrest, J. W. van der Meer, and Rheta MacGregor for technical help. I am grateful to A. Wilkes for lending me his data and photographs.

Literature Cited

Callahan, P. S. and T. Cascio. 1963. Histology of the reproductive tracts and transmission of sperm in the corn earworm, *Heliothis zea*. Ann. Entomol. Soc. Am. 56: 535–556.

Callahan, P. S. and J. B. Chapin. 1960. Morphology of the reproductive systems and mating in two representative members of the family Noctuidae, *Pseudaletia unipuncta* and *Peridroma margaritosa*, with comparison to *Heliothis zea*. Ann. Entomol. Soc. Am. 56: 763–782.

Drecktrah, H. G. 1978. Morphology of the internal reproductive system of the adult female army cutworm, *Euxoa auxiliaris*. Ann. Entomol. Soc. Am. 71: 923–927.

Fatzinger, C. W. 1970. Morphology of the reproductive organs of *Dioryctria abietella* (Lepidoptera: Pyralidae (Phycitinae)). Ann. Entomol. Soc. Am. 63: 1256–61.

Franclemont, J. G. 1951. The species of the *Leucania unipuncta* group, with a discussion of the generic names for the various segregates of *Leucania* in North America. Proc. Entomol. Soc. Wash. 53: 57–85.

———. 1980. "*Noctua c-nigrum* in eastern North America, the description of two new species of *Xestia* Hübner (Lepidoptera: Noctuidae: Noctuinae). Proc. Entomol. Soc. Wash. 82: 576–586.

Hudson, A. and L. P. Lefkovitch. 1980. Two new species of the *Amathes c-nigrum* complex (Lepidoptera: Noctuidae) distinguished by isozymes of adenylate kinase and by selected morphological characters. Proc. Entomol. Soc. Wash. 82: 587–598.

McDunnough, J. 1943. Phalaenid notes and descriptions (Lepidoptera). Can. Entomol. 75: 59–62.

Outram, I. 1971. Morphology and histology of the reproductive system of the female spruce budworm, *Choristoneura fumiferana* (Lepidoptera: Tortricidae). Can. Entomol. 103: 32–43.